



## OPTOELECTRONIC EMITTER-RECEIVER DEVICE

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The subject of the present invention is an optoelectronic emitter and/or receiver device. It more particularly finds application in the field of high-rate optic connections, notably those respecting usage

10 standards for telecommunications. In the prior art, a device of this type is known, which has a printed circuit on which is positioned an optic emitter-receiver, to emit or receive these optic signals that are exchanged with an optic connector positioned facing 15 this optic emitter-receiver. Such devices dissipate a large amount of energy, and are generally provided with a radiator or cooler in order to assure their cooling. The interest of the invention is that it presents an optoelectronic device provided with a radiator, in such 20 a way that the radiator also serves for a mechanical support for the device.

In the prior art, a parallel optic connection is known from the teaching of document IEEE 078035234 3/99 Electronic Competence and Technologic Conference. This 25 parallel optic connection uses an emitter-receiver and a complementary connector linked to an optical fiber. For this purpose, it has a printed circuit on which is

present an emitter-receiver having aligned photodiodes, the printed circuit being designed so that the complementary connector can be mounted on the surface of this printed circuit and presented facing the optic  
5 emitter-receiver. For example, the complementary connector has optical-fiber ends connected to this connector with a spacing of its ends equal to the spacing between the photodiodes and the emitter-receiver.

10 Moreover, in order to assure the correct mounting of the complementary connector on the printed circuit, the printed circuit has two openings and the connector correspondingly has two guiding pins. The position of the optical fiber ends is precisely defined with respect  
15 to the guiding pins, and likewise, the position of the photodiodes is precisely defined with respect to the printed circuit openings. Thus, during the mounting of the complementary connector on the surface of the printed circuit, one ends up with a precision optic  
20 connection between the optical fibers and the optic emitter-receiver.

This parallel optic connection also has a metal base so as to be able to dissipate the heat emitted by the assembly of electronic components borne by the  
25 printed circuit, notably that emitted by the

photodiodes. The metal base is a plate applied against one face of the printed circuit, preferentially facing the emitter-receiver. In a preferred example, this metal base also has alignment openings. Thus, the metal  
5 base can also receive centering pins from the complementary connector.

In this example, the printed circuit is flexible, and it has several segments permitting a connection with different devices. For example, a first segment is  
10 designed to be connected with the complementary connector. In this case, the metal base is applied against only this first segment. On the other hand, a second segment of the printed circuit is provided to be connected, by a bead soldering system, to another  
15 device, such as a motherboard, for example. Generally, such a device has a third printed-circuit segment, and said third segment is provided more particularly to receive passive components.

This optoelectronic device of the prior art poses a  
20 problem. In fact, such an optoelectronic device releases a great deal of heat. Now the metal base provided to serve as a radiator is generally of a size that is smaller than the printed circuit. In fact, since the printed circuit is flexible, and the different  
25 segments of this circuit are not necessarily aligned,

the metal base, which is a rigid plate, cannot follow the different segments of the printed circuit. Therefore, in general, the interest in this metal base is limited to the role of radiator, in the very 5 restricted zone where the latter is positioned.

Moreover, the flexible printed circuit risks being abraded at the level of the periphery of the metal base. In fact, since this metal base is local, it presents projecting boundary edges to the flexible printed 10 circuit. For example, if the flexible printed circuit is curved in such a way that it is folded on the metal base, then the projecting boundary edges risk cutting the base locally. Moreover, since the metal base is of very fine thickness, this curvature of the flexible 15 printed circuit can lead to the formation of a very crimped bend around this metal base and therefore risks adversely affecting the conductive strips provided in this area on the flexible printed circuit.

The object of the present invention is to solve the 20 problem posed by the optoelectronic device of the prior art. In fact, the optoelectronic emitter and/or receiver device of the invention more particularly provides a device having a printed circuit such that this printed circuit is applied against a radiator, this 25 radiator having a form such that it has several distinct

faces. The printed circuit has at least one optic receiver and/or emitter, and can receive at least one complementary optic connector, such that the centering pins of this connector can be inserted into the openings 5 of the circuit. In this connection position, the optic contacts of the complementary connector are positioned facing the contacts of the optic emitter-receiver of the circuit.

The printed circuit of the invention is particular 10 since it has a first segment applied against a first face of the radiator, and a second segment of this same printed circuit applied against a second face of this same radiator. The particular quality of the invention resides in the fact that the two faces onto which the 15 printed circuit is applied are separate, or, for example, contiguous. The printed circuit also has a flexible segment, such that this flexible segment assures a connection between the first segment and the second segment. The flexible segment permits notably 20 placing the first and the second segments on different planes. Consequently, the radiator plays a role of physical support for at least these two segments of the printed circuit, and protects them from adverse effects.

The invention therefore concerns an optoelectronic 25 device having a first printed-circuit element, on which

is mounted an optic emitter and/or receiver, this first printed-circuit element having at least two openings to receive the centering pins of an optic connector that can be mounted facing the optic emitter and/or receiver,  
5 this device also having a radiator, being characterized in that the first printed-circuit element is applied against a first face of the radiator, and in that a segment of the flexible printed circuit connects the first printed-circuit element to a second printed-  
10 circuit element, this second printed-circuit element being applied against a second face of the radiator, this second face being separate from the first face.

The invention will be better understood upon reading the description which follows and upon  
15 examination of the figures that accompany it. The latter are given only by way of indication and do not in any way limit the invention. The figures show:

-- Figure 1: An exploded view in perspective of an optoelectronic device according to the invention;  
20 -- Figure 2: A view of one face of a printed-circuit element of an optoelectronic device according to the invention.

Figure 1 shows an optoelectronic device 1 according to the invention. The device 1 has a printed circuit 2,  
25 a connector 3, and a radiator 4. Printed circuit 2 has

an optic emitter-receiver 5. Optic emitter-receiver 5 has optic contacts 6 to respectively send or receive optic signals. Emitter-receiver 5 is an electro-optic transformation component. For example, emitter-receiver 5 is a matrix of diodes called VCSEL (Vertical Cavity Solid Emitting Laser), or a PIN photodiode matrix. In one variant, optic contacts 6 are diodes, solely for emitting a signal. In this variant, emitter and/or receiver 5 is a simple optic emitter.

Emitter-receiver 5 can also be a zone of the printed circuit allowing the ends of optical fibers to flare out, since these optical fibers, for example, can be included in the thickness of the printed circuit. Then optic contacts 6 correspond to these optical-fiber ends.

Printed circuit 2 also has two openings 7, these openings 7 being preferentially positioned on either side of emitter-receiver 5. Openings 7 then form a pair. They are precisely positioned relative to optic contacts 6. In one variant, one can provide for printed circuit 2 to have several openings such as 7, and then in one preferred mode of embodiment of this variant, it can have several pairs of openings 7.

Openings 7 are more particularly provided to receive centering pins. For this purpose, centering

pins 8 are present on optic connector 3 in order to be able to place this optic connector 3 in a correct manner on the printed circuit. In addition, centering pins 8 are precisely positioned relative to the optic contacts 5 (not shown) of connector 3. In fact, the face-to-face positioning of connector 3 with emitter-receiver 5 requires a very great precision given the precision required for optic connections in general.

Connector 3, for example, is connected to a cable 9 10 comprised of optical fibers 10. Optical fibers 10, for example, are arranged inside connector 3 in such a way that the ends (not shown) of these optical fibers 10 are flared out at the level of a front face 11 of connector 3. This front face 11 is designed to be placed facing 15 contact matrix 6.

The flared ends of optical fibers 10 are then placed face-to-face with optic contacts 6.

Moreover, optic contacts 6 are spaced so that a spacing between these optic contacts is of the order of 20 the spacing of those [fiber ends] presented on connector 3. When connector 3 is mounted on printed circuit 2, centering pins 8 cooperate with openings 7 when connector 3 is positioned correctly with printed circuit 2, so as to assure a correct optic pathway between these 25 two elements.

Emitter-receiver 5 is more particularly positioned on a first element 13 of printed circuit 2. This first element 13, for example, has other electronic devices 14 mounted at the surface of a face 15 of this element 13.

5 Emitter-receiver 5 is also present on this face 15. For example, a device 14 can be an amplifier, or a signal processing component. In this case, the first element 13 has strips (not shown) permitting connecting optic emitter-receiver 5 with these other devices 14. As

10 shown in Figure 2, this first element 13, in one preferred example of embodiment, has two emitter-receivers such as 5. Printed circuit 2 can thus receive one or two connectors. In this example, the first element 13 has two pairs of openings 7. The openings of

15 a pair are respectively positioned on either side of emitter-receiver 5 presented on this face 15. In such a case, a complementary connector having two pairs of centering pins such as 8 can be mounted on this printed circuit 2.

20 First element 13, for example, is very small in size. For example, a width 16 of this element 13 is of the order of 10 millimeters. In a preferred example, first element 13 has a square shape. In this preferred example, a space 17 between two openings 7 of the same

25 pair is of the order of 6.5 millimeters. Consequently,

a width 18 of an emitter-receiver 5 is smaller than space 17. For example, this width 18 is of the order of 2 to 2.5 millimeters. Moreover, this face 15 has an amplifier 19, such that amplifier 19 has, for example, a 5 width of the order of 1.7 millimeters. Moreover, face 15 can also have a drive circuit 20 of a width of the order of approximately 2 millimeters.

First element 13 of printed circuit 2 has face 15, and also a second face 23. This second face 23 is 10 opposite [on the back of] face 15, while being parallel to it. The first element 13 is a plate of a small thickness 24. Face 23 is applied against radiator 4. In the example shown in Figure 1, face 23 is applied against a first face 25 of this radiator 4.

15 In a preferred mode of embodiment, this first face 25 also has openings 26, such that, when first element 13 is applied against first face 25, openings 7 are positioned facing openings 26. For this purpose, first face 25 has at least one pair of openings 26 to be 20 placed opposite the pair of openings such as 7. Thus, when connector 3 is mounted on face 15 of first element 13 of printed circuit 2, centering pins 8 can also be inserted into opening 26, and held there. Thus, 25 openings 26 can participate in a correct positioning of connector 3 on printed circuit 2.

Radiator 4 is preferentially made of a material permitting dissipating a large quantity of heat. It is characterized by good heat exchange capability.

Radiator 4 permits making rigid the overall  
5 structure of this device 1. For example, radiator 4 is a module of parallelepiped form thus having a second face 27. This second face 27 is separate from first face 25. In the example shown in Figure 1, the second face 27 is a secant with regard to first face 25. In a  
10 preferred mode of embodiment, face 25 is perpendicular to second face 27. For example, radiator 4 can have a perforated face 28. This perforated face 28 can have one or more cavities 29. Cavities 29 are hollow toward the inside of the parallelepiped formed by radiator 4.  
15 In the example shown in Figure 1, cavities 29 also open onto at least one other face 30 of radiator 4. Cavities 29 are separated from one another by walls 31 of a certain thickness. Moreover, the total surface created by such a radiator 4 is clearly increased by the  
20 interplay of these cavities 29 and walls 31. The increase in the contact surface between the external environment, for example, air, and the radiator permits a better dissipation of heat.

Printed circuit 2 also has a second printed-circuit  
25 element 32. Second element 32 is connected to first

element 13 by means of a segment of flexible printed circuit 33. In this example, printed circuit 2 at least has the following three segments: first element 13, second element 32 and flexible segment 33. By the play 5 of flexible segment 33, the printed-circuit elements 13 and 32 can be placed in different planes. In fact, flexible circuit 33 can be positioned so as to form an elbow 33. In a preferred example, elbow 33 forms an angle 34 of the order of 90°.

10       In the example shown in Figure 1, first element 13 and second element 32 are made up of rigid printed-circuit segments, while segment 33 is flexible. In one variant, segments 13, 32 and 33 can all be flexible. In this case, printed circuit 2 is made up of a single 15 continuous piece, and the segments correspond simply to different orientations. Segments 13, 32 and 33 of printed circuit 2 are applied to the periphery of radiator 4.

The second printed-circuit element 32 therefore has 20 a surface complementary to first element 13 to receive connectors, and/or components, and/or still other electronic devices to be connected with device 1. For example, the second printed-circuit element 32 can receive the connection elements permitting the coupling 25 of device 1 to a complementary device 35, for example,

on a motherboard. In a preferred mode of embodiment, the connection between the second element 32 and complementary device 35, for example, is assured by a system of microbeads. The electrical and physical bond 5 created by the microbead system is more particularly described in documents US-A-6,024,584 and US-A- 5,598,033. The connection is then assured by solder beads 36, beads 36 being positioned so as to form a pattern respecting a certain geometry to allow a unique 10 correct connection of complementary device 35 that can be connected with second element 32. Beads 36 are micro-soldered, and are currently called "ball grid array", according to the Anglo-Saxon terminology, by the person with average skill in the art.

15 In the mode of embodiment where the printed circuit is entirely flexible and in which first element 13 and second element 32 are also flexible, such as shown in Figure 2, device 1 has reinforcing plates 37. Reinforcing plates 37 permit making the printed circuit 20 rigid. These reinforcing plates 37 are more particularly positioned at the level of openings 7. Moreover, these reinforcing strips 37 are generally arranged on a periphery of the printed-circuit elements 2 in order to facilitate their handling and to prevent 25 incorrect positioning of flexible printed circuit 33.

In fact, if the printed circuit is flexible, the zone where the bend must be made is uncertain, but in the presence of reinforcing plates 37, these folding zones are limited, and thus a correct placement of printed 5 circuit 2 on radiator 4 is assured. In fact, there is a preferred position for segment 13 relative to first face 25 and of second element 32 relative to second face 27.

These reinforcing plates can be of a thickness calibrated so as to control the space between the 10 surface of optic components 6 and the end of fibers 10.